

REMARKS

The Examiner has rejected claims 11-19 pursuant to 35 U.S.C. §112, first paragraph, because they do not read on FIG. 3A (the elected species). Claims 11 and 15 have been amended to remove reference to a lower barrier layer and claim 13 directed to the spacer has been canceled. It is respectfully asserted that claims 11-12, and 14-19 remaining in the application as of this amendment now read on FIG. 3A of the elected species. Withdrawal of this rejection is respectfully requested.

The Examiner has rejected claims 11-19 pursuant to 35 U.S.C. §103(a) as unpatentably obvious over Hawley et al., in view of Jain et al., and further in view of Gangopadhyay. This rejection is respectfully traversed.

In the Office Action mailed on January 8, 2007, The Examiner appears to read the phrase “adhesion-promoting layer” in isolation, divorced from the other claim limitations to which it relates and without considering the issue of to what materials adhesion is supposed to be promoted. Plainly, the phrase “adhesion-promoting layer” has no meaning in isolation, since whether a layer will be “adhesion-promoting” is completely dependent on the adjacent layers with respect to which adhesion is to be promoted. The legal authority cited by the Examiner is inapposite on this point. It appears that the Examiner has not given consideration to this issue.

The Examiner’s comments in the Office Action mailed on January 8, 2007 make it quite clear that the basis for the rejection is simply that the Examiner has found the individual components of the claimed antifuses in different prior-art references that relate to antifuses. The rejection and the rationale set forth by the Examiner for the rejection simply views each component layer of the claimed antifuse in isolation and then reasons that since all of the components are found in antifuses it would be obvious to configure an antifuse as claimed by taking the amorphous silicon antifuse structure of Hawley et al., combining it with the TaN barrier metal material of the amorphous silicon antifuse

from Jain et al., and substituting an amorphous carbon antifuse material from Gangopadhyay in place of the amorphous silicon antifuse material disclosed in the other two references. This rejection is untenable.

First, no one skilled in the art would look to the structure of an amorphous silicon antifuse such as disclosed in Hawley et al. and Jain et al. to configure an amorphous carbon antifuse. These materials have different properties including programming mechanisms and compatibility with other layers. One cannot simply arbitrarily mix and match individual component layers from device to device as the Examiner has clearly done here.

In particular, whether an individual material is an “adhesion-promoting layer” with respect to the layers found in an amorphous silicon antifuse has nothing to do with whether it will exhibit that function in an amorphous carbon antifuse. An “adhesion-promoting layer” has to adhere to both materials with which it is in contact (i.e., the material above it and the material below it). The fact that the references teach that SiN functions as an “adhesion-promoting layer” with respect to other materials does not, as the Examiner apparently believes, mean that it is obvious that this material can perform the same function in the antifuse of the present invention.

None of the “functional language” cases cited by the Examiner stand for such a proposition. The Examiner has given no consideration to a critical portion of the “function” of the adhesion-promoting layer, namely, the materials with respect to which adhesion is to be promoted. Such materials are clearly a part of any “function” attributable to the claim language at issue. The Examiner cannot ignore the portion of the function comprising the materials to which the chosen “adhesion-promoting layer” material is supposed to adhere, since they are necessary to the definition of the function of adhesion promotion.

The Examiner appears to have simply, and incorrectly, assumed that the function “adhesion-promoting layer” is a universal function, and reasons that therefore once a material is identified in a reference as an “adhesion-promoting layer” in one context it is automatically assumed for prior-art purposes that it will perform that function in all instances for all combinations of materials with which it is in contact. This is manifestly untrue and is especially problematic for amorphous carbon, which is notorious as a material that does not easily adhere to other materials.

In addition, the particular claimed antifuse structure is unobvious over the prior art of record because the claimed combination unexpectedly exhibits markedly different and superior characteristics when compared with amorphous silicon antifuses and other amorphous carbon antifuses employing different combinations of barrier layers and adhesion promoting layer materials.

Evidence of these unobviously different characteristics are set forth in the specification of the above-identified patent application. The graphs in FIGS. 11 through 13 and the accompanying explanatory text in the specification (see paragraphs [0083] through [0087]) of the instant application demonstrate a marked and unobvious difference in performance between prior-art amorphous carbon antifuses and amorphous carbon antifuses according to the claims at issue. By examining where the curves of FIG. 11 meet the Y-axis, it may be seen that the average programmed resistance of the prior-art amorphous carbon antifuses is about 300 ohms. In addition, the spread of programmed resistances in these devices is between about 180 ohms and about 380 ohms (i.e., a spread of about 200 ohms). Both the resistance spread and the average resistance of prior-art devices are unacceptable for use in an antifuse-based FPGA product. This problem is explained at paragraphs [0005] and [0006] of the instant application.

In contrast, the average programmed resistance of the antifuses in FIGS. 12 and 13 is seen to be about 55 ohms, dramatically less than that of the prior-art antifuses. In addition, the spread of programmed resistances is seen to be between about 45 ohms and about 75 ohms (i.e., a spread of about 30 ohms), also dramatically less than that of the prior-art antifuses. Both the average resistance and the resistance spread are dramatically better in the antifuses of the present invention, the average resistance being about 18% of the average resistance of the prior-art antifuses, and the resistance spread being 15% of the resistance spread of the prior-art antifuses.

In order to obtain an average programmed resistance of about 55 ohms in an amorphous silicon antifuse, programming currents in the range of about 15-25 mA, as opposed to less than 5 mA would be needed. At programming currents in the range about 15-25 mA, many of the amorphous silicon antifuses would be destroyed. The particular combination of antifuse material, barrier layer material and adhesion-promoting layer material as presently claimed and the superior characteristics and performance results in a commercially-viable antifuse, while other combinations known in the prior art relied upon by the Examiner do not result in commercially-viable antifuses. Such dramatic differences in characteristics and performance are completely unexpected and are strong evidence of non-obviousness.

If the Examiner has any questions regarding this application or this response, the Examiner is requested to telephone the undersigned at 775-586-9500.

Respectfully submitted,  
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